01-017

SOLAR SELECTIVE ABSORBER COATINGS FOR HIGH TEMPERATURE APPLICATIONS

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The concentrated solar power (CSP) technology is being used for electricity production in large-scale plants. One of the CSP technologies is based on parabolic-trough systems, where the energy is absorbed in a solar selective coating deposited onto the absorption tube, which reaches high temperatures (up to 400 ºC in midtemperature applications). The elevated temperatures for a prolonged period require an excellent thermal stability of the materials used for the receiver tube. Hence, the focus is not only on the optical properties of the receiver tube but also on the long term (>20 y) durability and oxidation resistance of the solar selective coating. Within the frame of this work, two different thermal solar selective coating stacks were developed, one based on (Al,Si)Ox:W cermets and, as an alternative concept, another based on AlSiNx/AlSiOyNx like ceramic layers. Both were prepared by magnetron sputtering and deposited on stainless steel substrates using a metallic tungsten (W) layer as back reflector. The coating stacks were completed by a SiOx or AlSiOx as antireflection (AR) layer. Spectrophotometer measurements, X-Ray diffraction (XRD), Scanning Electron Microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) were used to characterize the optical properties, the crystalline structure, morphology, composition and chemical bonding of these coatings. The spectral optical constants of the single layers were calculated from the reflectance and transmittance measurements using the modelling software SCOUT and used to design the 4 layer optical stack. The coatings exhibit an absorptance of 93%-96% and an emissivity of 8%-14% (at 400 ºC). The coatings also exhibit good thermal stability, with small changes in the optical properties of the coating during heat-treatments at 400 ºC in air and at 580 ºC in vacuum